Quantifying Changes in Terrestrial and Aquatic Ecology in the Yukon River Basin

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Climate change in northern ecosystems creates potential for large-scale change in terrestrial and aquatic ecology. The USGS Yukon River Basin Project (YRB) focuses on understanding the changes in lakes and terrestrial ecosystems and their impacts on carbon, water, and energy (Figure 1).

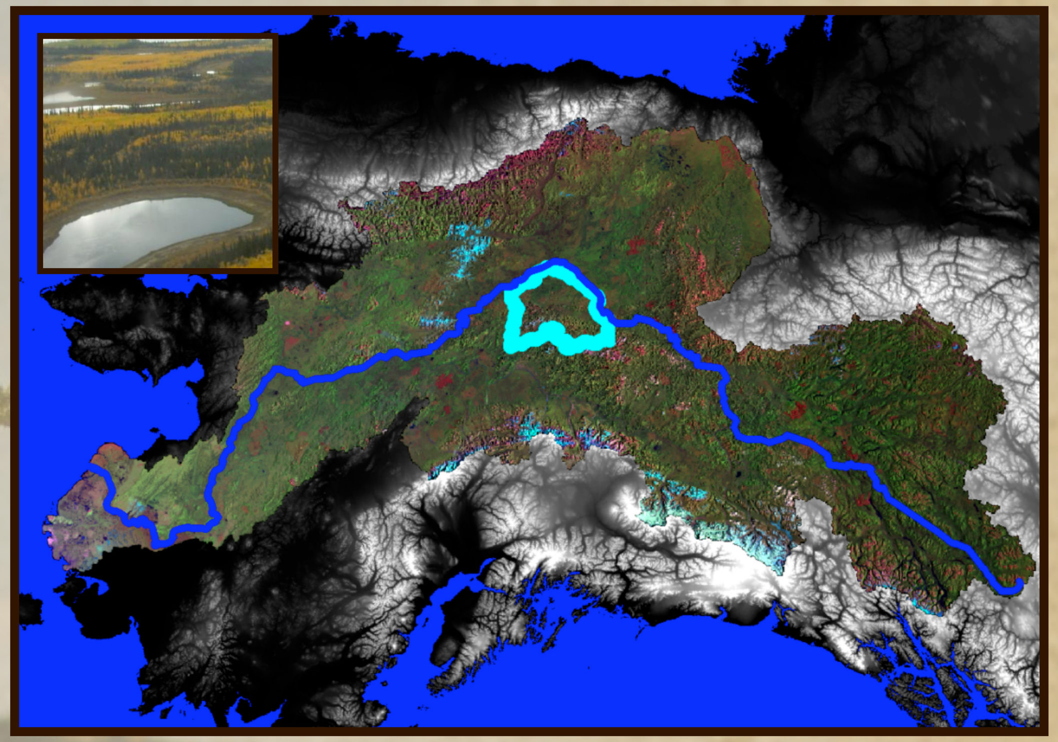

Figure 1. Yukon River Basin covers portions of Alaska and Canada. The Birch Creek and Beaver Creek watersheds were selected as an initial study site.

A field sampling campaign gathered information on soil moisture, organic layer thickness, active layer depth, biomass, and plant species compositions in Yukon Flats in the fall of 2009. Field data were collected from 22 sites within two landscapes representing loess hills, dominated by near surface continuous permafrost and deep lakes, and the floodplain with deep permafrost and oxbow lakes (Figure 2).

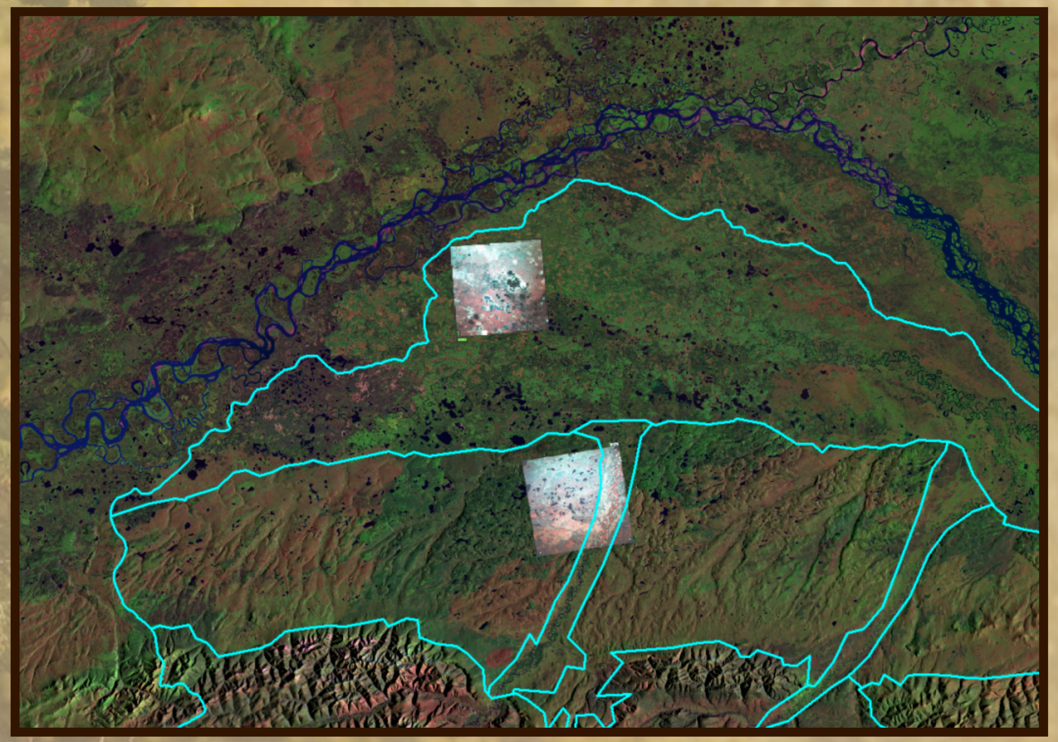

Figure 2. Intensive sites at Boot and Canvasback Lakes represent loess hills with near surface permafrost and the flood plains with deeper permafrost, respectively.

Preliminary analysis of Landsat data provided mappable soil-moisture relationships that are used to examine moisture change within this landscape (Figure 3). Tree and shrub biomass was also mapped using NDVI, SR [B4/B3], NDWI7 [(B4-B7)/(B4+B7)], temperature, elevation, CTI, and run-slope with $R^2 = 0.87$ (Figure 4).

Achillea Borealis

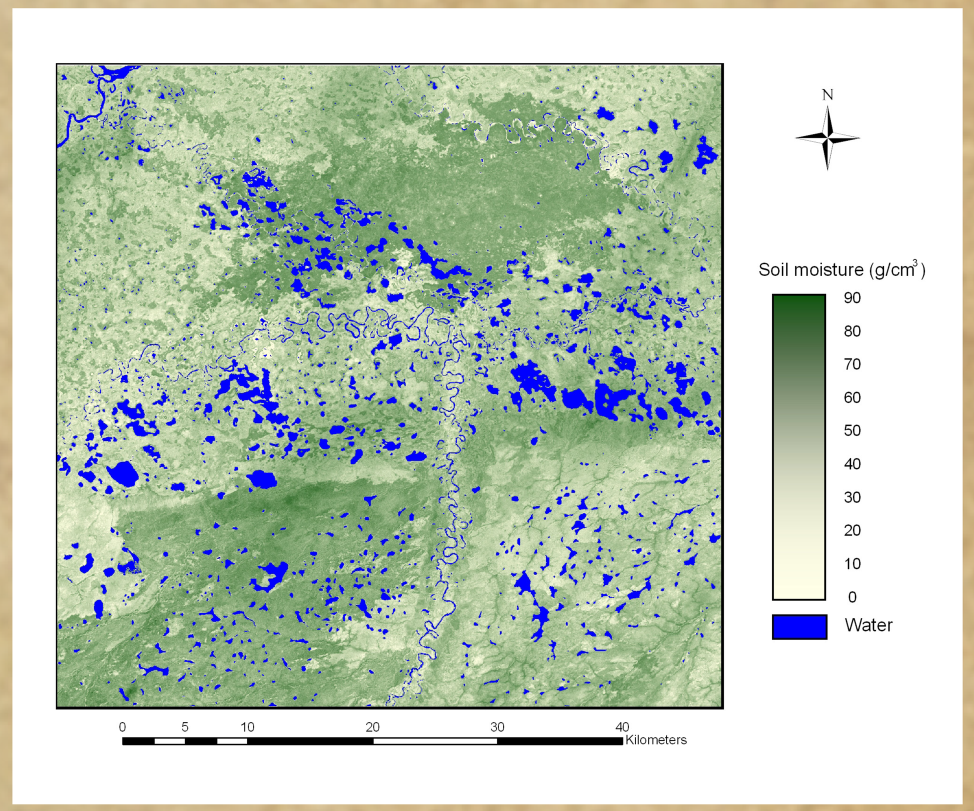

Figure 3. Volumetric soil moisture mapped using Landsat NDII [(B2-B5)/B2+B5)] and surface temperature ($R^2 = 0.58$).

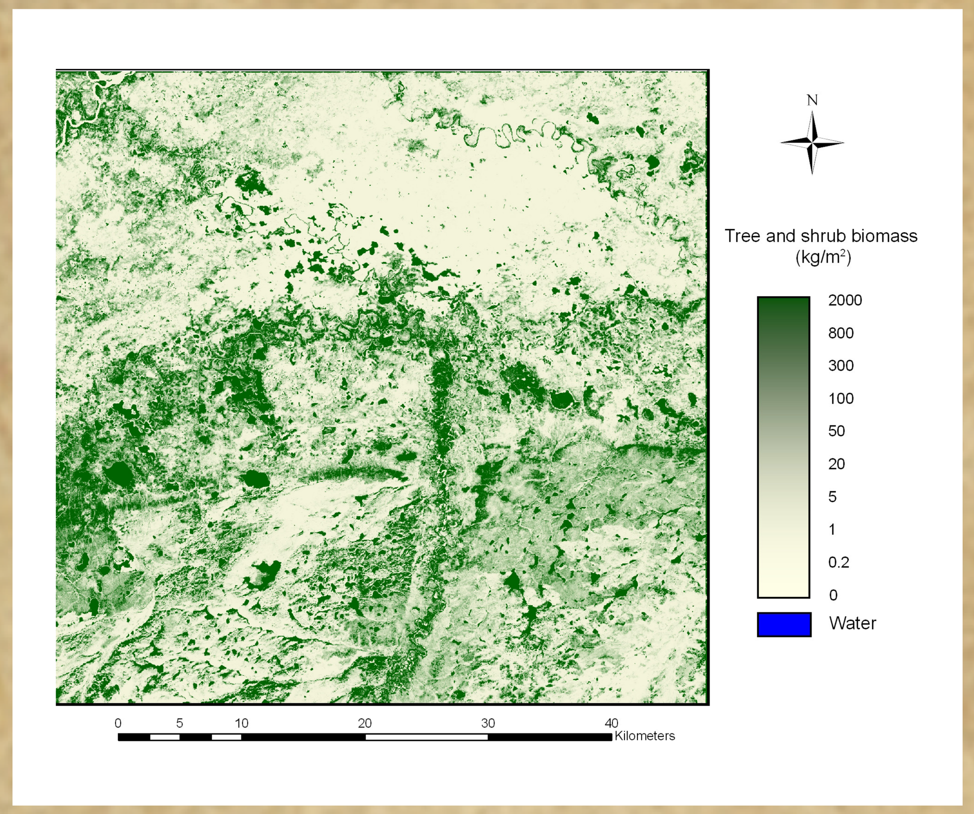

Figure 4. Tree and shrub biomass estimated from Landsat data.

High resolution LiDAR data obtained for the study sites will be used for mapping biomass and generating a digital elevation model (DEM) (Figure 5).

Landsat and high resolution imagery quantified lake surface water dynamics and documented the 2009 Yukon River flood and 2004 fire effects (Figure 6).

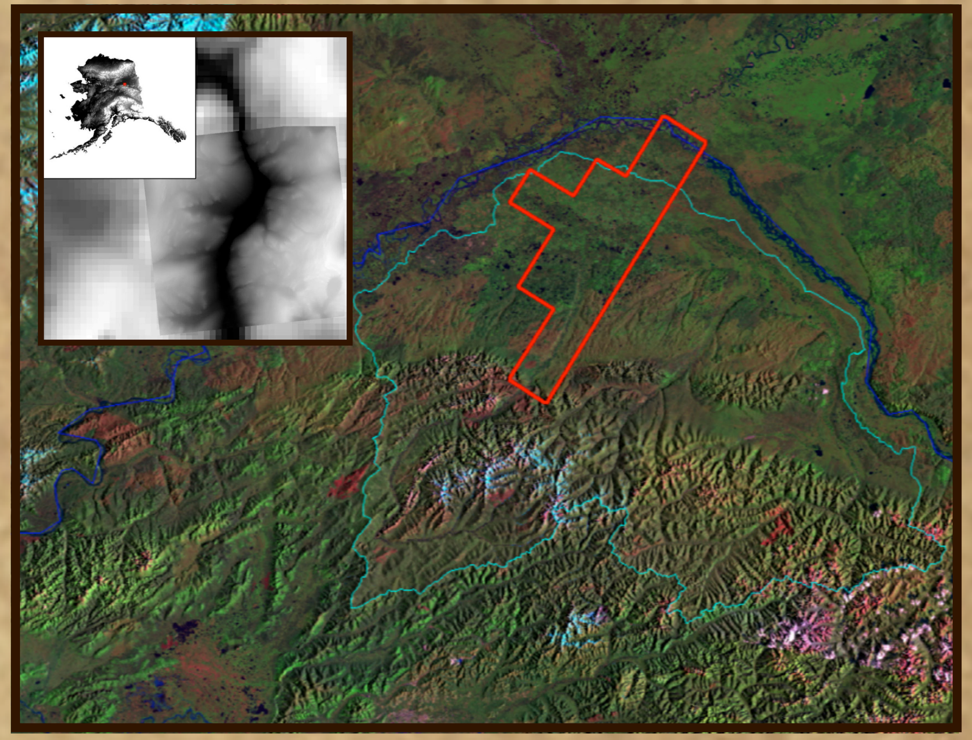

Figure 5. LiDAR extent will provide a 2.5 m resolution DEM and a canopy structure map with less than 35 cm vertical accuracy.

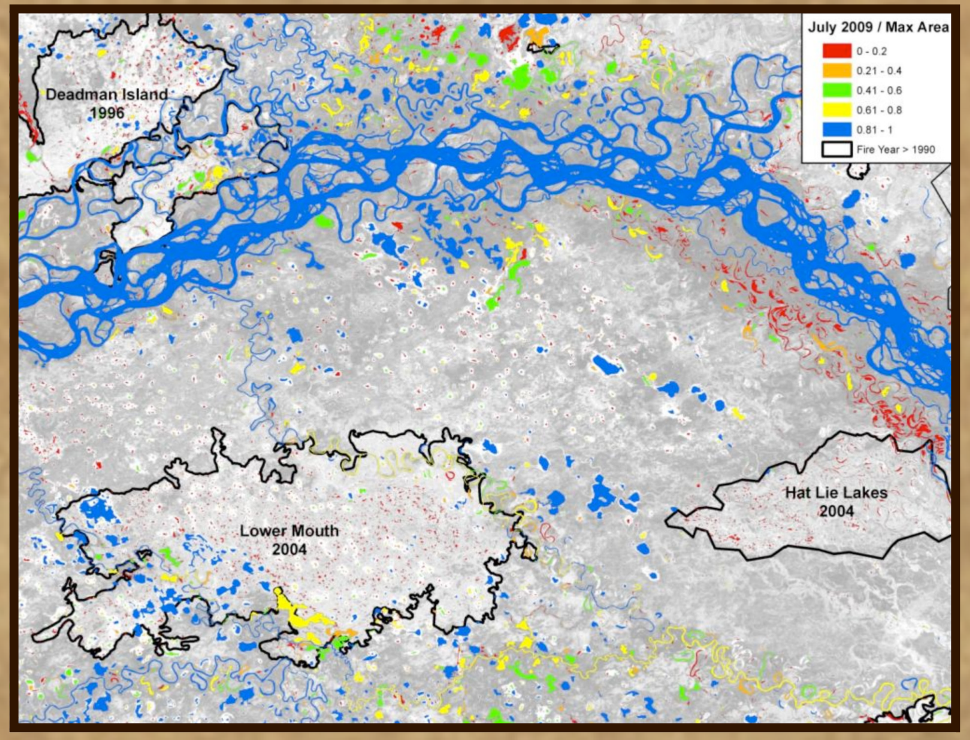

Figure 6. Surface water dynamics derived from Landsat data.

The project supports the development of user friendly MODIS NDVI and surface reflectance data (eMODIS) at 250 m, 500 m, and 1 km resolutions for Alaska and the Yukon Territory of Canada (Figure 7).

Boreal forest performance anomalies accounting for weather related variations in plant productivity were mapped at a resolution of 250 m for the Yukon River Basin from 2000-2005. This allowed for the tracking of weather and non-weather (disturbance) ecosystem performance trends seperately. Areas performing significantly below or above their weather-based expectation (performance anomalies) had decreasing trends in recent fires and increasing trends in older fires (Figure 8).

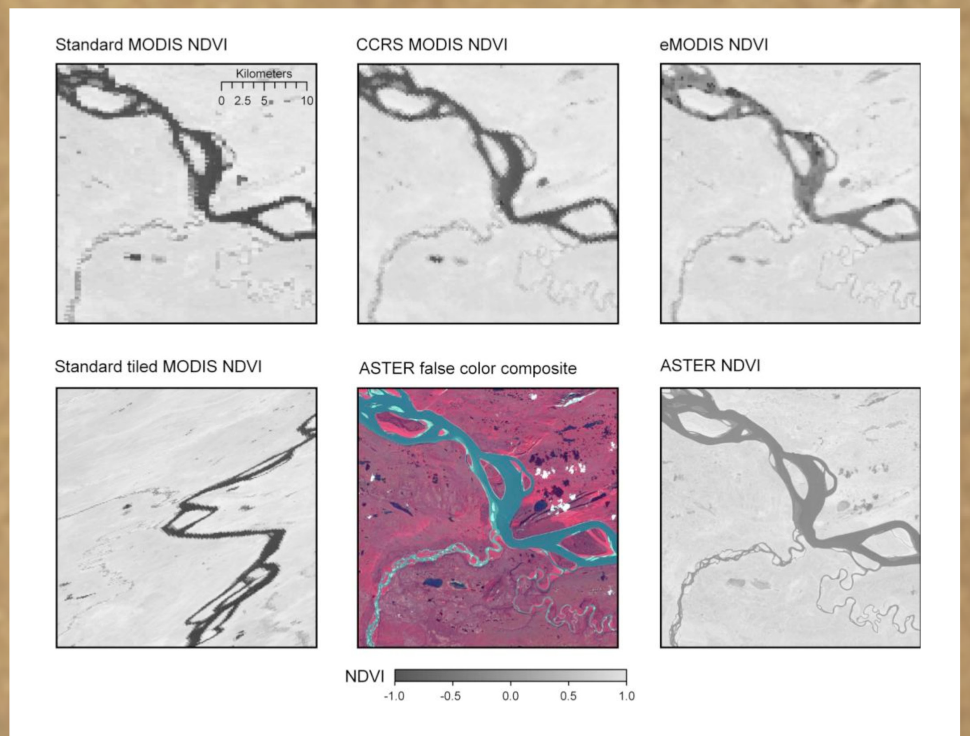

Figure 7. User-friendly MODIS products (Albers Equal Area projection and GeoTIFF format) have better geometric consistency than standard MODIS (ftp://emodisftp.cr.usgs.gov/eMODIS/).

Future Goals

Studying the impacts of changes in soil moisture at local and regional scales on:

- Carbon storage
- Greenhouse gas fluxes
- Above and below ground community composition
- Soil organic matter

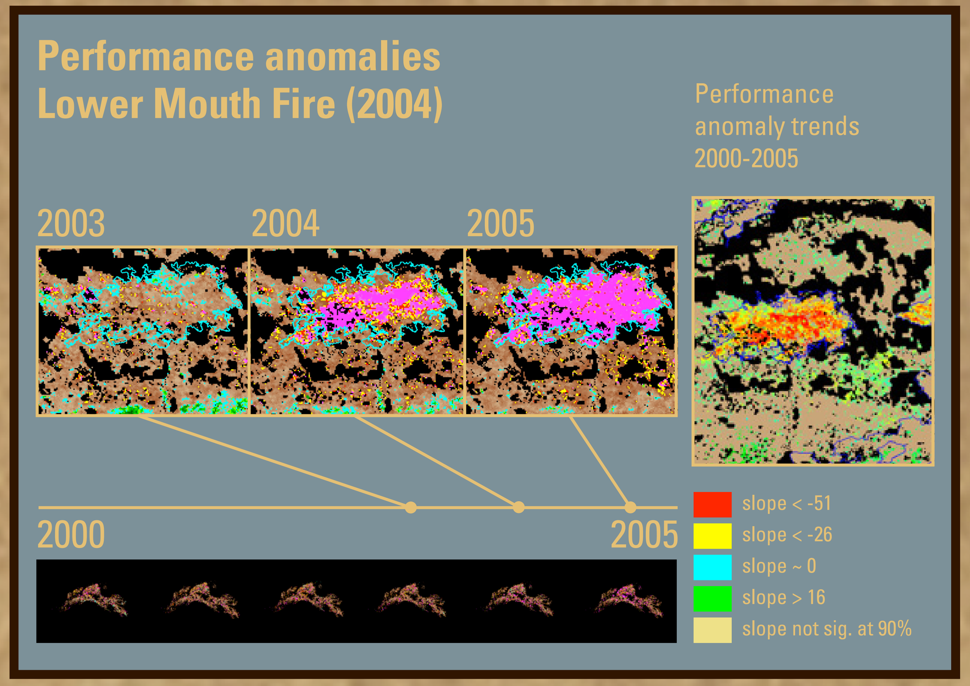

Figure 8. Tracking of disturbance trends.

Funding: USGS Climate Effects Network and Earth Surface Dynamics.

Carex Aquatilis